

Evaluation of Infrared Bioceramic MIG3/Textile Composite in Cutaneous Microcirculation Improvement

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Introduction.

The FIR bioceramics have the characteristic of to absorb the heat issued from the body and give back *Far Infra-Red Electromagnetic Radiation* (wavelength = 4 – 1000 μm). These FIR radiations bio-stimulate the body metabolism improving the blood circulation and lymphatic systems. In this way, the *Far Infrared Clothing Therapy* has a great potential as a helpful tool to reduce inflammation and pain in addition to activate the basic functions of the skin.

Materials and Methods.

Bermuda shorts made of polyamide with elastane impregnated with FIR bioceramic MIG3 powder by INVEL Co. technology were clinically evaluated by *Infrared Image Technique* as a cutaneous microcirculation improvement tool. 30 patients with age from 27 to 66 years old, identified with cutaneous microcirculation malfunctions, were studied according to the following stages: (1) selection of patients; (2) INVEL infrared bermuda shorts dressed by half of the selected patients and placebo bermuda shorts by the other half of patients during 20 days and 8 hours a day; and (3) evaluation of the results.

The bioceramic powder characteristics were determined by WDXRF, XRD and FTIR techniques and the bioceramic/textile composite used in the INVEL bermuda shorts by SEM and FTIR techniques.

Results and Discussion.

The chemical composition of the bioceramic MIG3 is shown in the Table I through its oxide percentages. The MIG3 major crystalline phase was identified as Al_2O_3 .

Table I - Chemical composition of bioceramic MIG3.

Compounds	Al_2O_3	SiO_2	ZnO	BaO	CaO	Others
%	49.03	29.78	10.29	9.00	0.53	1.37

The FTIR spectra of textile and textile/bioceramic MIG3 composite can be seen in the Figure 1. It is easy to identify the textile with MIG3 spectrum in the FIR range above the 100% of reflectance, meaning the capability of additional reply to the absorbed energy from the FTIR equipment.

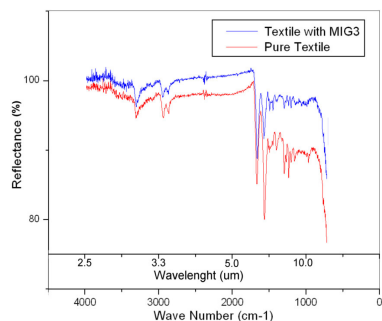


Fig.1. FTIR spectra for textile and textile/bioceramic MIG3 composite.

The SEM micrographs of the textile and bioceramic/textile composite used in the INVEL T-shirts are displayed in Figure 2. As it can be observed, the textile fibers were not modified by the bioceramic process impregnation and the distribution the bioceramic powder over the textile fiber is homogeneously well presented.

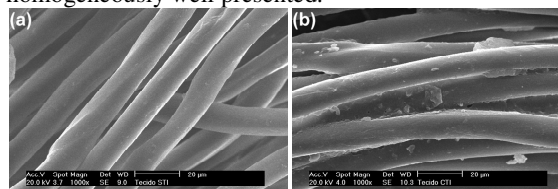


Fig.2. SEM topographical images of (a) textile and (b) textile/bioceramic MIG3 composite.

The clinical evaluation, realized by High Resolution Infrared Image technique, according the coloured digitalized images with temperature values varying from 22 $^{\circ}\text{C}$ (black) to 36 $^{\circ}\text{C}$ (white), was done by the colours map representing the heat effect due to microcirculation that can be insulated or not by localized fat tissue in the hypoderm. This can be shown in the Figure 3.

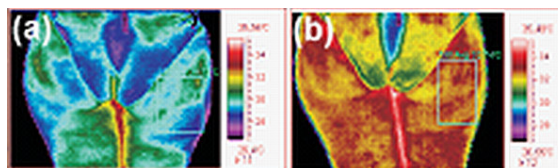


Fig. 3. Infrared images of one patient: (a) before test and (b) after 20 days dressing the bermuda shorts.

Conclusions.

- The bioceramic MIG3 shows to be capable of Far Infrared Reflectance;
- The bioceramic MIG3/textile composite reflects in the FIR range with more intensity than the pure textile;
- There was a small cutaneous temperature changes in the body of patients dressing placebo bermuda shorts along 20 days of test (-0.1°C). By other side, the patients using INVEL bermuda shorts showed an average cutaneous temperature change of 1.92°C .
- The bioceramic MIG3/textile composite used in the INVEL bermuda shorts has demonstrated by Infrared Image Technique be capable to improve significantly the cutaneous microcirculation in all of patients.